PAN-PACIFIC ENTOMOLOGIST
77(4): 254–260, (2001)

THE *RUSTICA* SPECIES GROUP OF HAWAIIAN *DROSOPHILA* (DIPTERA: DROSOPHILIDAE)

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Abstract.—The *rustica* group, NEW SPECIES GROUP, of Hawaiian *Drosophila* is proposed based on unique characteristics of the male labellum and female ovipositor. The structure of the labellum is similar to the sclerotized labellum found in the closely related *haleakalae* species group, although additional modifications are also present. Three species are placed in this group, *D. curiosa* Hardy & Kaneshiro, NEW SPECIES, a new species endemic to Hawai'i, *D. praesutilis* Hardy, a species from O'ahu, and *D. rustica* Hardy, from the islands of Maui and Moloka'i.

Key Words.—Insecta, Diptera, Drosophilidae, Hawaiian *Drosophila, rustica* species group, *Drosophila curiosa.*

Although the *picture wing* species group has been extensively studied, the basal lineages within the Hawaiian *Drosophila*, such as the *haleakalae* species group and its relatives, are largely unknown. Throckmorton (1966), based upon examination of a variety of internal morphological characters, suggested that the *ciliated tarsus* species *D. imparisetae* Hardy was closely related to the *haleakalae* species group (Fig. 1A). Spieth (1966) confirmed this close affinity based on field observations of mating behavior. He found that males from both *D. imparisetae* from the *ciliated tarsus* group, and *D. fungiperda* (Hardy 1966), from the *haleakalae* group, "took station" on leaves of shrubs and small trees where they could be easily seen by observers. These hypotheses, however, were based on a small number of taxa and were not analyzed in a rigorous phylogenetic context.

Recently, molecular data has been used to determine the phylogenetic relationships among the Hawaiian Drosophilidae. Bonacum (2001), in contrast to other molecular work (Kambysellis et al. 1995, Baker & DeSalle 1997), has recently suggested that the *ciliated tarsus* species group is not basal within the Hawaiian *Drosophila* lineage or closely related to the *haleakalae* group at all (Fig. 1B). Instead, he placed the *ciliated tarsus* species within a clade of leaf breeding taxa, including the *modified tarsus* and *antopocerus* species groups (Fig. 1B). The *haleakalae* group is entirely mycophagous (Heed 1968). The *ciliated tarsus* species, however, have been reared from a variety of substrates, predominantly leaves (*Cheirodendron, Clermontia*) but also including fruits (*Clermontia, Myrsine* and *Sapindus*), stems (*Cheirodendron, Clermontia*), fungus, and ferns (Heed 1968).

This recent shift in notions concerning the relationships within the Hawaiian *Drosophila* highlights two points. First, systematic relationships within and among some of the major groups of Hawaiian *Drosophila* should be considered preliminary, as they are based on only a few taxa or rigorous phylogenetic studies. Second, the ecological habits of these groups, as suggested by Heed (1968), may

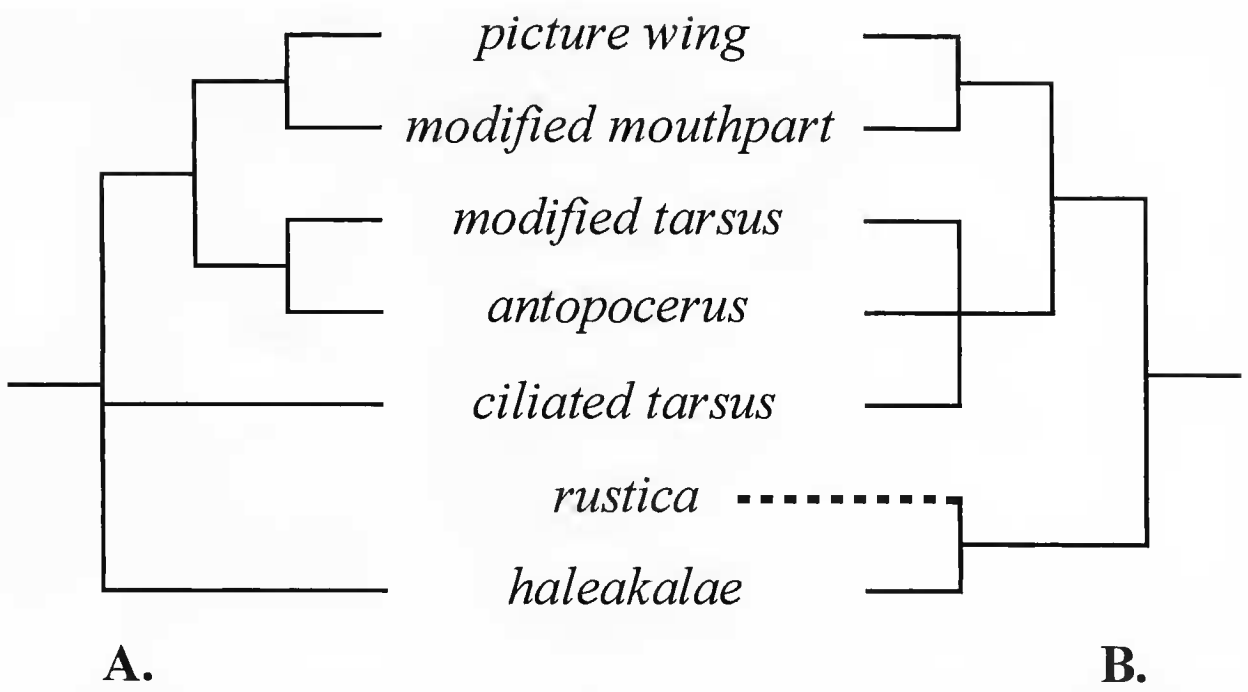


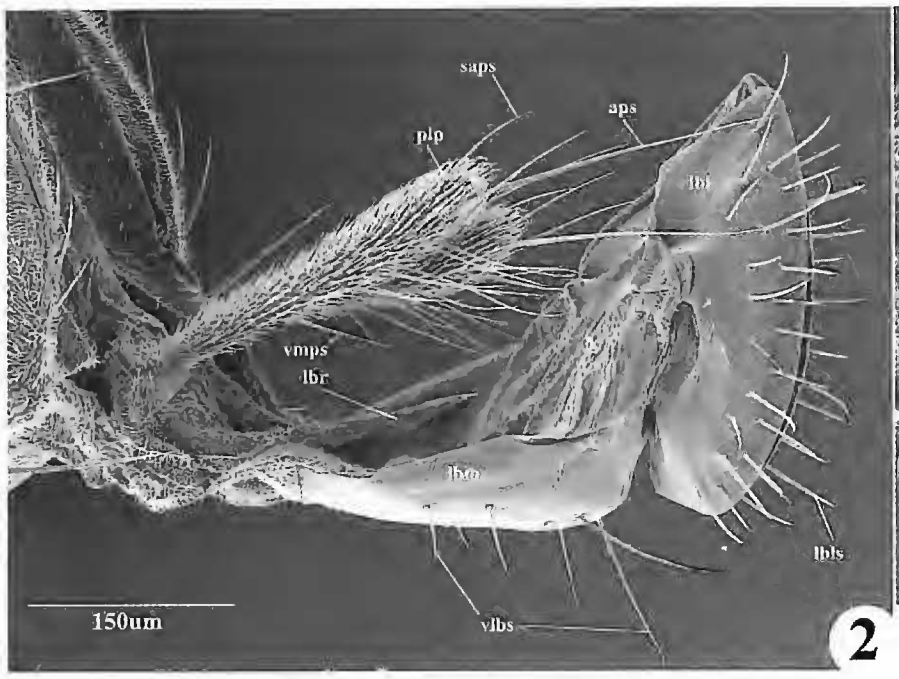
Figure 1. Proposed phylogenetic relationships in the Hawaiian *Drosophila*. (A) Morphological hypothesis proposed by Throckmorton (1966). (B) Molecular phylogeny of the Hawaiian *Drosophila* (Bonacum, 2001) with a tentative placement (dashed line) of the *rustica* species group.

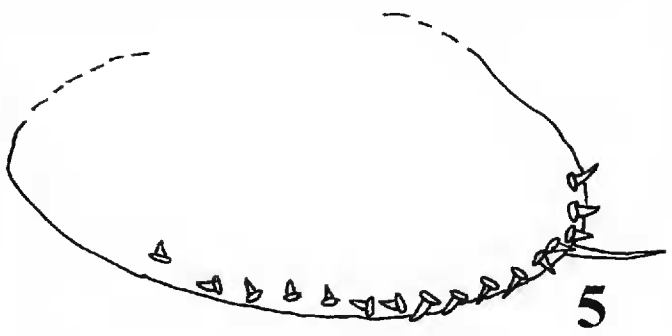
be more reliable indicators of phylogeny than male secondary sexual characteristics.

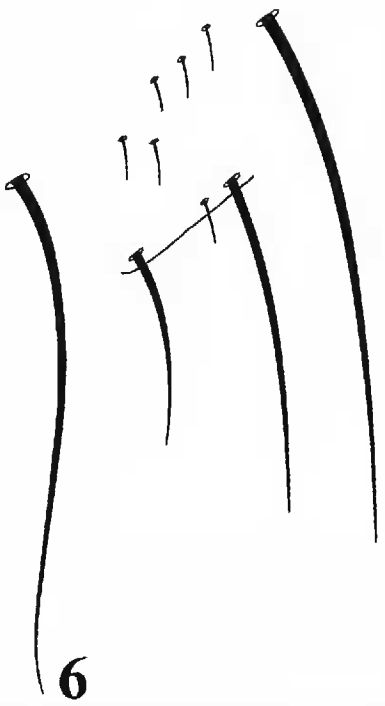
The *rustica* group is difficult to place definitively because it possesses morphological characters which are found in other groups. Males of the three species placed in the *rustica* group possess a heavily sclerotized labellum, a character typically found only in the *haleakalae* species group (Figs. 2, 3). The labellar structure in *D. rustica* differs from that of the *haleakalae* group in that two additional peg-like seta are present on the dorsolateral margin of the labellum (Fig. 3). Females of *D. rustica* are also distinct, possessing heavily sclerotized spermathecae, a character not seen in any *haleakalae* group species. The cilia on the foretibia of *D. rustica* males closely resembles that of some *ciliated tarsus* species (Hardy 1965: 453; fig. 182b), suggesting a close relationship among these groups, even though males of *D. curiosa* and *D. praesutilis* lack ciliation on the foretarsi. However, it should be noted that ciliation on the forelegs of Hawaiian *Drosophila* males is quite common and may have arisen independently multiple times *via* sexual selection. As such, it may not be the best character on which to base the placement of the *rustica* species group. Because of the limited number of specimens of *D. curiosa* and *D. praesutilis*, the spermathecae and labellae of these species were not examined in detail. We are tentatively placing the *rustica* group close to the *haleakalae* group (Fig. 1B), but are unable at this time to determine the exact phylogenetic affinities of this group. Further study of morphological and molecular characters will be required to determine the relationships between the *rustica* group and its close relatives in the *haleakalae* and *ciliated tarsus* groups.

Materials and Methods

When possible, a variety of measurements were made from representatives of each species in the *rustica* species group (Sturtevant 1942, Grimaldi 1987). Abbreviations and definitions used include: thorax length (TL), distance from anterior notal margin to the posterior apex of the scutellum; wing length (WL), maximum







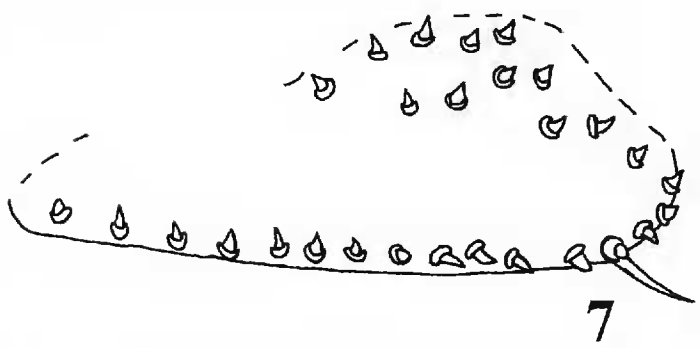


Figure 2. *Drosophila multiciliata*, lateral view of mouthparts. aps—apical palpal setae, lbl—labellum, lbls—labellar setae, lbm—labium, lbr—labrum, plp—palp, saps—subapical palpal setae, vlbs—ventral labial setae, vmps—ventro-medial palpal setae.

Figure 3. *Drosophila rustica*, apical view of labellum with dorsolateral peg setae.

Figure 4. *Drosophila curiosa*, posterolateral region of mesonotum.

distance from the humeral crossvein to the apex of the wing; ratio of thorax length to wing length (TL/WL); head width (HW), greatest distance between apical margins of the eyes; ratio of head width to thorax length (HW/TL); costal index (CI), length of costa from subcostal break to R2+3/length of costa from R2+3 to R4+5; fourth vein index (4V), length of M1 from crossvein dm-cu to apex/length of M1 from crossvein r-m to crossvein dm-cu; length of CuA1 from crossvein dm-cu to apex/length of crossvein dm-cu (5X); length of costa from R2+3 to R4+5/length of M1 from crossvein r-m to crossvein dm-cu (4C); and length of CuA1 from crossvein dm-cu to apex/length of M1 from crossvein r-m to crossvein dm-cu (M).

Drosophila curiosa Hardy & Kaneshiro, New Species
(Figs. 4, 5, 8)

Diagnosis.—*D. curiosa* differs from closely related forms by lacking ciliation on the front tibia or tarsi; having wings hyaline with a comparatively long costal fringe and crossvein r-m located near the middle of cell 1st M2; and with pleurae and scutellum which are entirely pale yellow. The labellum of males possesses a heavily sclerotized black rim.

Types.—Holotype, male, deposited B. P. Bishop Museum (BPBM #16356) poor condition, wing broken off; data: USA, HAWAIIAN ISLANDS. *HAWAI'I:* Kapua Land Section, Hoopuloa Quadrant, slopes of Mauna Loa, South Kona, 2650 ft., Jul 1977, D. E. Hardy, TL = 1.1 mm; HW = 0.8 mm; HW/TL = 0.8. Allotype, female, deposited BPBM # 16356a; data: same data as holotype, TL = 1.0 mm; WL = 1.8 mm; TL/WL = 0.5; HW = 0.8 mm; HW/TL = 0.8; CI = 2.4; 4V = 2.5; 5X = 2.2; 4C = 1.3; M = 0.5.

Description.—Male, Female. Head. Mostly yellow; black rim of labellum present in male, absent in female; head appendages yellow; medial portion of occiput, vertex, frontal triangle and parafrontalia extending to proclinate setae brown; frontal triangle shining, extending almost to level of proclinate setae; arista of male with six dorsal and three ventral rays in addition to apical fork, female arista with four dorsal and three ventral rays in addition to apical fork, inner margin of arista with five to six short, inconspicuous, widely-spaced setulae.

Thorax. Mostly yellow to rufous, with faint tinge of brown on sides of mesonotum; mesonotum subshining, lightly yellow-gray pollinose; one slightly enlarged black seta, two times longer than other setae, present in each dorsocentral row opposite anterior supraalar setae; posterolateral area of mesonotum sparsely setose (Fig. 4). *Legs.* Entirely yellow, lacking ornamentation; front basitarsus half as long as tibia. *Wings.* Hyaline, costal fringe extending about 3/5 the distance between apices of veins R2+3 and R4+5; section of vein Ml +2 between r-m and dm-cu crossveins equal in length to last section of vein M3+4. *Abdomen.* Mostly rufous, tinged with brown; fourth and fifth tergites pale yellow except for narrow basal margin of former; male genitalia not studied; ovipositor oval in shape (Fig. 5), apex with about four peg ovisensilla, ventral margin with thirteen peg ovisensilla which extend to 3/4 ovipositor length, dorsolateral region lacking ovisensilla, inner subapical ovisensilla about 1/4 ovipositor width.

Distribution.—Known only from the Big Island of Hawai'i (Fig. 8).

Etymology.—This species is named *curiosa* because it possesses a mixture of characteristics which make it difficult to place.

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Figure 5. *Drosophila curiosa*, lateral view of ovipositor.

Figure 6. *Drosophila rustica*, lateral view of ovipositor.

Figure 7. *Drosophila rustica*, posterolateral region of mesonotum.

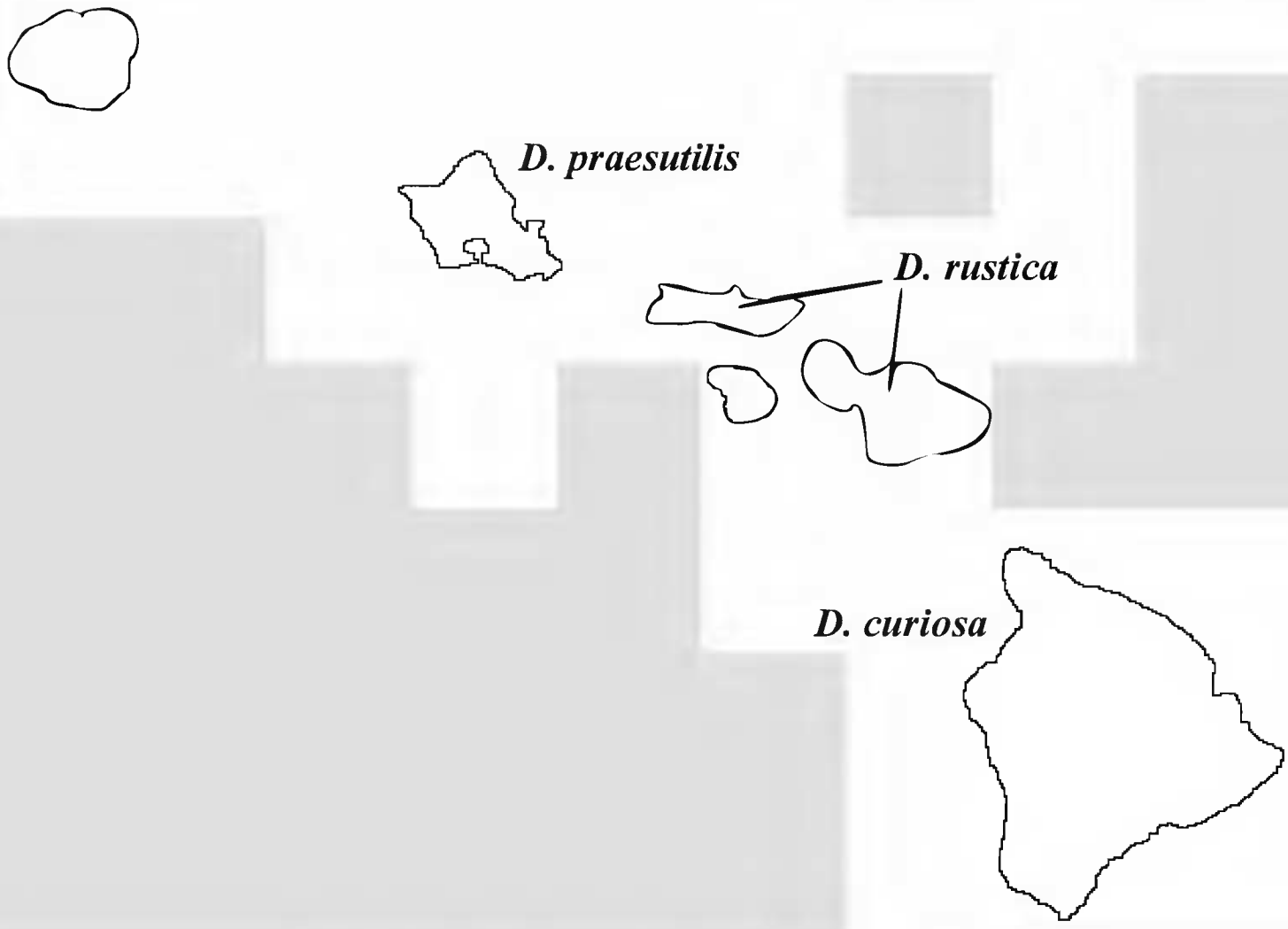

Figure 8. Distribution of *D. curiosa, D. praesutilis*, and *D. rustica.*

Drosophila praesutilis
(Fig. 8)

Drosophila praesutilis Hardy 1965: 422.

Diagnosis.—D. praesutilis differs from members of this group by having three strong pairs of dorsocentral setae, anterior pair situated presutural.

Types.—Holotype, male, deposited BPBM #6422, hindlegs beyond coxae and abdomen missing; apical ½ of right wing torn off, left wing torn in 1/2 on anterior and posterior margins, genitalia in microvial mounted below specimen (Evenhuis, 1982); data: USA, HAWAIIAN ISLANDS. *O'AHU:* Pupukea, Jul 1952, D. E. Hardy.

Description.—Refer to Hardy (1965).

Distribution.—Drosophila praesutilis is endemic to O'ahu (Fig. 8) and known only from the type male.

Discussion.—This species is being placed in the *rustica* species group because of it's entirely pale yellow body and labellar characters. Nothing is known of the habits or the biology of these species. The female has not been associated.

Drosophila rustica
(Figs. 3, 6–8)

Drosophila rustica Hardy 1965: 452.

Diagnosis.—D. rustica differs from other species treated here by having the front tibia and tarsi ciliated, wings evenly infuscated, costal fringe short, crossvein

r-m near basal ⅓ of cell M2, and the upper half of each pleuron distinctly tinged with brown. *D. rustica* is treated here because of the presence of a black sclerotized rim on the labellum of the male. Females can be differentiated from members of the closely related *haleakalae* group by having well sclerotized, mushroom-shaped, spermathecae and by their distinctive ovipositor morphology.

Types.—Holotype, male, deposited BPBM #6438, apices of left and right wings punctured and torn off (Evenhuis 1982); data: USA, HAWAIIAN ISLANDS. *MOLOKA'I:* Pu'u Kolekole, 3600 ft, Jul 1953, D. E. Hardy and M. Tamashiro. TL = 1.1 mm; WL = 2.6 mm; TL/WL = 0.4; HW = 0.9 mm; HW/TL = 0.9; CI = 4.1; 4V = 1.8; 5X = 1.2; 4C = 0.6; M = 0.5. Paratype, 1 male, deposited University of Hawai'i Entomology Collection (UHEC); data: same as holotype, TL = 1.0 mm; WL = 2.3 mm; TL/WL = 0.4; HW = 0.8 mm; HW/TL = 0.8; CI = 5.3; 4V = 1.6; 5X = 1.5; 4C = 0.5; M = 0.3.

Description.—Male. Head. Labellum heavily sclerotized, with two sharply pointed, peg-like setae on dorsolateral margin (Fig. 3). *Thorax.* Area surrounded by inner and outer postalar, supraalar and posterior dorsocentral setae on each side of mesonotum sparsely setose in both sexes (Fig. 6). *Legs.* Cilia present on tibia and tarsi (Hardy 1965: 453; fig. 182b). Refer to Hardy (1965) for a description of additional male characters. *Female.* Fitting description of males, except for sexual characters. *Abdomen.* Ovipositor with distinctive clump of prominent ovisensilla on distal portion (Fig. 7); spermathecae well-sclerotized and mushroom-shaped (not shown).

Distribution.—Endemic to Moloka'i and Maui (Fig. 8).

Material Examined: USA, HAWAIIAN ISLANDS, MAUI: Ridge above Kaulalewelewe, 3000–4000 ft, 4 Aug 1964, D. E. Hardy, 1 male. Waikamoi, 4300 ft, 9 Aug 1964, H. L. Carson, 1 male. Waikamoi, 29 Jun 1965, L. H. Throckmorton, 1 male. *MOLOKA'I:* Pu'u Kolekole, 3600 ft., 20 Jul 1964, H. L. Carson, 2 males, 3 females. South of Hanalilolilo, 3600 ft., 2 Mar 1966, K. Resch, 1 male. Material deposited UHEC.

Discussion.—Five females from the Big Island which resemble *D. rustica* have also been studied. It is not possible at this time to determine whether these are conspecific with *D. rustica* or represent another member of the *rustica* species group.

Acknowledgments

The authors would like to thank the editor and two anonymous reviewers for helpful comments on this manuscript.

Received 5 Oct 2000; Accepted 9 Jul 2001.

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